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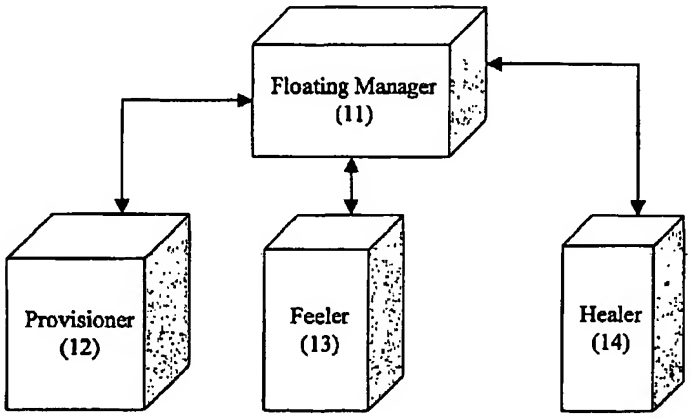
(54) Title: A SYSTEM AND METHOD FOR AUTONOMOUS NETWORK MANAGEMENT OF A HOME NETWORK



(57) Abstract: An autonomous network management system for the home/small network that enables the common user to setup and manage a network, by providing automatic and self-sufficient installation, management and troubleshooting of a network. According to a prefered embodiment of the present invention, new network devices can be automatically installed, without any user intervention, and the network can be managed from any of the network devices, using a floating distributed network management method. The network management system includes a complete suite (11, 12, 13, 14) that provisions and installs the home network, monitors, performs proactive connectivity and performance tests, provides statistics and fixes the network when it is under performing. The present invention thereby provides a virtual MIS to configure, maintain and troubleshoot the network. This is performed using an expert system for networking problems that makes the home network a self-healing autonomous network. The present invention includes a centralized management console that controls and manages thousands of these home/SOHO network management systems to allow efficient support and management by a communication service provider.

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A SYSTEM AND METHOD FOR AUTONOMOUS NETWORK MANAGEMENT OF A HOME NETWORK

FIELD OF THE INVENTION

The present invention relates generally to autonomous networking of computer systems and network devices. More particularly, the invention relates to the autonomous management of multiple network devices connected to a home and SOHO (Small Office Home Office) network such as computers, network appliances, mobile devices, entertainment appliances, PDA's, etc., where such management is executed automatically for all network devices, and where thousands of these small network management systems are remotely managed and controlled from a single centralized location.

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BACKGROUND OF THE INVENTION

Today, the number of multiple PC households is growing faster than the number of households acquiring their first PC. A typical household will buy its first computer before the children are born. Later on they will purchase another computer, typically for business or for playing with by the kids. This creates a situation where the family is fighting for resources such as the Internet, Printers etc. This drives the need to create a home network.

Furthermore, home offices are becoming more prevalent today as more people start their own small businesses, and as enterprises become more distributed and have many small remote offices. In addition. High-level executives now have a home office provided by their enterprise to allow them to continue to work even when they are at home.

The benefits of a home or SOHO network are enormous, providing productivity enhancement as well as shorter return on investment on computer systems and network devices. A multiple PC household or SOHO would typically benefit from a home networks, by enabling sharing of a single Internet access account (with a single IP), software application sharing, file sharing, printer sharing, sharing music and video, multi-player games, single CD burner available to all network devices, instant messaging , data back up etc.

However, home and SOHO networks are only common among technology savvy people, who are the early adopters, since it is currently a real IT (Information Technology) challenge to install and maintain a home or SOHO network at home. This challenge is mentioned as the barrier of entry to most consumers in all recent market research and analyst reports, as exemplified by a September 2002 report by The Yankee Group: "Setup and configuration of home networks remains a difficult task for consumers, *vendors must provide effective self-installation guides and extensive customer support.*" Another example, is a July, 2002 report by Jupiter Research: *"... four key impediments that stand between consumers and the desire to install a PC-based* ***home network:*** *high cost,* ***complexity of network set-up and maintenance****, complexity of technology choices (wired, wireless) and uncertainty about sources of information and distribution channels."*

Current home and SOHO networks, whether wireline or wireless, use different network protocols to communicate between the network devices (PC and other network appliances). The user needs to understand and perform these network

configurations in order for the network to be functional. This is exactly the reason why there are so many households with multiple PC's but so few of them have a home network. In addition, the solving of the home or SOHO network configuration complexity actually triggers a much more complex problem. After the network is running things can still go wrong and network malfunction caused by hardware failure or software issues are likely to arise. The typical home or SOHO user does not have the know-how to resolve these issues.

Contemporary types of home and SOHO networks include networks connected by telephone wires, Powerline wires, Ethernet wires and wireless connections. These network technologies typically connect PC's to a home network. But since PC's are not the only systems that require connections to the Internet (and subsequently to a home or SOHO network), vendors from a variety of industries are developing network appliances such as: refrigerators that are Internet-enabled, WebTV, online MP3 music players and mobile wireless Personal Digital Assistant (PDA's). Sony Corporation (Tokyo), for example, has recently announced that an 802.11b wireless network interface is included with all high definition televisions that it ships. All of these devices will eventually be connected to the home/SOHO network. In a network environment where so many network-enabled devices are connected together, the need for a network management system becomes clear. The users of the network need visibility and tools to manage and maximize the effectiveness of the network.

The home network management system cannot be the typical network management system that is commonly found in enterprises or even small to medium size businesses. A home network management system has to manage itself, as it is not practical or affordable for the owner of a home network to employ an administrator to always be around to understand what is going on and how to change or fix configurations. In enterprises, there is commonly a network administrator for every 50 -70 users. The typical household or SOHO does not have a "techno geek" to act as the house Manager of Information Systems (MIS).

A variety of communication service providers (cable operators, ISP, telcos, etc.) are waking to the opportunity that the home networking challenge is presenting. These services are starting to offer home networking service and support. This is indicated in an Instat/MDR report from December 2002: ""The growth in home networking also opens up new opportunities for service providers, as consumers look to their Broadband Service Provider (ISP) for home networking equipment, and services. The future ISP roll-outs of residential gateways, voice, security, video

content sharing and home automation services can provide service providers with new revenue sources. "

The problem these service providers are facing is that supporting home/SOHO networks is a very costly operation involving on-site and support center activities.

There have been various attempts to enable automatic network configuration in a variety of networks and for different applications as shown below.

U.S. Patent No. 6,128,729 describes a method and system for automatic configuration of network links to attached devices. This patent deals with networks that have multiple segments and presents an automatic method ensuring that only one link is configured between bridges and repeaters, eliminating the possibility of setting more than one link as might happen when a human being performs the link configuration. This creates a more efficient network topology.

U.S. Patent No. 5,577,023 describes a method and apparatus for automatic configuration of a network connection. It deals with automatic swapping of the TX and RX wires of an Ethernet cable connection eliminating connectivity problems when the wrong cable is used, for example, a cross cable instead of a straight cable.

U.S. Patent No. 6,012,088 describes an automatic configuration for an Internet access device. It requires a telephone connection to be established first so that a centralized server can be accessed. The device then receives the specific configuration parameters and automatically configures Internet access.

U.S. Patent No. 6,098,116 describes a process control system including a method and apparatus for automatically sensing the connection of devices to a network. It deals with automatic sensing and configuring of I/O controllers for a system including physical switches or pneumatic devices.

U.S. Patent No. 6,314,459 describes home network auto configuration. It only deals with one of the needs in the art, i.e., configuration of resources after a network is already available. It builds on the Jini architecture by SUN. It provides functionality at a layer above the network. It does not, for example, solve the problem of automatic configuration of the network upon connection, disconnection, or reconnection. This invention uses the registering as a tool for auto-configuration. The present invention uses a wider variety of methods for automatic configuration, while also dealing with all other stages in the typical life cycle of the network such as the ongoing operation and maintenance of the network.

US. Patent No. 5,852,722, and 5,826,000 describe a System and method for automatic configuration of *home network* computers. It differs from the present

invention since it requires a specialized and dedicated auto-configuration server. Furthermore, it only deals with the Internet connection of the home network to the Service Provider.

Thus, there is a widely recognized need for a home/SOHO network system that can simplify and streamline the installation process as well as provide improved network performance and uptime. Furthermore, there is a need for a service provider system that can manage and control thousands of home/SOHO networks, enabling these service providers to control the cost of providing support services.

SUMMARY OF THE INVENTION

Accordingly it is a principle object of the present invention to provide an apparatus and method for an autonomous network allowing automatic and self-sufficient set up, operation, management and maintenance of a home/SOHO network, such that each device in the network is integrated automatically, and the network can be controlled and managed by any of the network devices. This autonomous networking solution includes an expert system for networking that manages the home network for the common user. In addition, the present home network management system provides services including: installation, provisioning, monitoring, usage analysis, diagnostics, reporting, troubleshooting, performance measurement and maintenance.

It is another principle object of the present invention to provide a centralized management and control system that can manage thousands of these home/SOHO network management systems. This allows communication service providers to efficiently act as the network managers for thousands of subscribers without dramatically increasing their operational (support) expenses and allowing them to make profits from such services.

It is another principle object of the present invention to provide the autonomous management of multiple network devices connected to a home network such as computers, network appliances, mobile devices, PDA's, etc., where such management is executed automatically for all network devices.

It is another principle object of the present invention to provide a method for automatic provisioning of applications across the small network. This means that when a software application is installed on one of the computers on the network then it automatically becomes available to other computers on the network through the system described in this invention. The system turns the remote computer into a terminal that operates the software application that still resides on the other computer. This amounts to changing the software license to be a floating license. The system automatically extends the user interface from one computer to the other (keyboard and mouse and application window display).

It is another principle object of the present invention to provide a method for automatic problem discovery, diagnostics and repair. The system constantly performs several tests covering two main issues – connectivity and performance. Once a test fails the system triggers into a self-healing mode. For example, if a computer is not able to print to a printer, the system will discover this, find the correct printer driver, either on the computer itself, on its peers on the network or on the Internet using the proprietary DSA (Driver Search Agent) described in the invention. Once this driver is found the system will automatically install it and fix the printing problem. The same method applies to all other resources such as Internet (re-installation of dialer, protocol stack and more), CD burners etc.

The present home network management system comprises of a complete suite that provisions and installs the home network, monitors and provides statistics and fixes the network when it is broken. It is a complete network management system for the home network, and does not require a skilled network administrator to set up or manage. The setting up of the network is done automatically and is transparent to the user. It is as if every home network has its own virtual MIS to configure, maintain and troubleshoot the network, thereby enabling a common user to leverage the power of networks, and maximize the performance received from the network.

The following table summarizes the key differences between the method of the present invention and the methods of traditional network management systems:

	Home Network	Prior art Network Management

	Management System	System
Characteristics	Transparent – no need for administrator	Require technicians & network administrators
	Distributed	Client/Server
	No single point of failure	Management server needs to be up all the time
	Active	Passive
	One PC install	Install on all PCs

This objective of the present invention is achieved through delivery of the following benefits: quick and easy network installation; easy provisioning of resources; application sharing and collaboration; maximization of network uptime; detailed reports of network usage; Automatic diagnostic and resolution of network problems.

The present invention provides a system and method for the management of home networks that include computers and other network devices (such as appliances and mobile communication devices). Such a network is enabled through the use of three core components: Provisioner; Feeler; and Healer. These components are managed and integrated by a Floating Manager.

The Provisioner automatically networks all computers and network devices, and automatically shares all available resources between them.

The Feeler automatically gathers information on the activity and traffic on the network, and allows the creation of network reports and diagrams.

The Healer automatically diagnoses, isolates and fixes network problems, transforming the home network into a self-healing network.

The Floating Manager interfaces between the different components of the system on the single computer level, while also performing communication, synchronization and information sharing with other Floating Managers that reside on other computer systems.

In addition, the system has a home/SOHO network Console that allows user interaction with the system from each and every computer.

Finally, the system also includes a Centralized Management Console that resides at the communication service provider's call center or central office. This console is connected through a secured Internet link to all Floating Managers in all

home/SOHO networks where the system is installed. It allows for remote management, control, troubleshooting, updates, alerts etc.

BRIEF DESCRIPTION OF THE DRAWINGS

The principles and operation of a system and a method according to the present invention may be better understood with reference to the drawings, and the following description, it being understood that these drawings are given for illustrative purposes only and are not meant to be limiting, wherein:

Fig. 1 is an illustration of the basic system architecture on a single network device, according to the present invention;

Fig. 2 is an illustration of the overall system architecture of the present invention on the network level, together with the system components;

Fig. 3a is an illustration of the service provider level system architecture of the present invention, including the connection to thousands of home/SOHO network management systems as described in the previous figures;

Fig. 3b is another illustration of the service provider level, depicting how a single home/SOHO network management system is connected to the Centralized Management Console at the service provider's facilities;

Fig. 4a illustrates a process whereby a simple network, where Internet connection is through a router, is autonomously setup for operation, according to a preferred embodiment of the present invention;

Fig. 4b illustrates a process, whereby a simple network, wherein the Internet connection is through a computer which acts as the Internet gateway, is autonomously setup for operation according to a preferred embodiment of the present invention;

Fig. 5 illustrates the different phases in the life cycle of a typical home network, which the present invention supports;

Fig. 6 is a flow chart illustrating the internal operation of the Provisioner including its algorithm and event handler;

Fig. 7 is a flow chart illustrating the internal operation of the Feeler including its algorithm and event handler;

Figs. 8a and 8b and 8c are flow charts illustrating the internal operation of the Healer including its algorithm and event handler;

Fig. 9a is a flow chart illustrating the algorithm of the Driver Search Agent that automatically searches for a specific driver suitable for a specific operating system, downloads it, and installs it in order to fix a printing problem;

Fig. 9b is a continuation of the flow chart of Fig. 9a;

Fig. 10 is a flow chart illustrating the algorithm used in the discovery of new systems in the network. It shows how ICMP "ping" is used to scan the range of applicable IP addresses in the search for new stations; and

Fig. 11 is a flow chart illustrating the algorithm used when the system is launched and it provisions itself for operation in the network. It emphasizes the self-decision making capabilities of the system. It will configure its IP address differently depending on the topology of the network, thus seamlessly configuring the network.

DESCRIPTION OF THE PREFERRED EMBODIMENT

According to the present invention there is provided an apparatus and method for setting up and managing a home network, such that each device in the network is integrated automatically, and the network can be controlled and managed by any of the network devices. In addition, the present home network management system provides services including: installation, provisioning, monitoring, usage analysis, diagnostics, reporting, troubleshooting, performance measurement and maintenance. The present invention thereby enables the common user to set up, manage and leverage the power of networks.

The following description is presented to enable one of ordinary skill in the art to make and use the invention as provided in the context of a particular application and its requirements. Various modifications to the preferred embodiment will be apparent to those with skill in the art, and the general principles defined herein may be applied to other embodiments. Therefore, the present invention is not intended to be limited to the particular embodiments shown and described, but is to be accorded the widest scope consistent with the principles and novel features herein disclosed.

Specifically, the present Invention comprises a complete suite that provisions and installs the home network, monitors, conducts proactive tests, provides statistics and finally even fixes the network when it is broken. It is a complete network management system for the home network, being configured and managed automatically and transparently, therefore not requiring a skilled network

administrator. The present apparatus provides a virtual MIS (Manager Information Systems) to configure, maintain and troubleshoot the network, thereby maximize the performance received from the network.

The management system delivers the following benefits to the home user: quick and easy network installation; easy provisioning of resources; provisioning of application sharing; maximization of network uptime; detailed reports of network usage; and Automatic diagnostic and resolution of network problems.

Reference is now made to **Fig. 1**, which relates to the basic system architecture. **Fig. 1** is an illustration of the basic system architecture on a single network device, according to the present invention. The system is comprised of three main elements: Provisioner, Feeler, and Healer. These three elements concurrently reside on all network devices connected to the network and are internal and independent. A floating manager, which resides on all systems, controls them but only one of these floating managers is the master actually managing the system at any given time. The master floating manager can change location according to the priority scheme presented later.

The system and method described herein are unique and different than typical network management systems. Whereas typical network management systems use client-server architecture, the present system uses a floating-agent technology for network management. According to this floating-agent technology, at any given moment, each of the computer systems connected to the network have a well-defined priority. The one with the highest priority is the current server that holds all of the information required to perform the tasks of the network management system, such as reports, troubleshooting etc.

Every selected time interval all the information on this current management console is transferred to all other network devices/PC's on the network. If a pre-configured amount of time passes with the current management console not initiating a synchronization update, the highest priority network device automatically becomes the management system master. This might happen when the current master PC is shut down, or experiences some kind of a failure. This ensures that as long as there is at least one PC that is operational, the network management system will continue to operate, providing all the required services, and maintaining a history record of past events and reports. This is required to allow effective troubleshooting and fixing of network malfunctions using a variety of techniques such as configuration restoration, driver updates and more as will be explained later. The resulting system

is a robust network management solution that is not dependent on a single server, with no single point of failure.

The Floating Manager **11** enables management of the network by any of the network devices. The network is, therefore, not client-server based, but is completely distributed. Floating Manager **11** installs itself, and all other required components of the network management system, on any new device that is discovered on the network, by sending a self-executing program to the remote PC, which installs the floating manager on this new system. In addition the user can invoke a console, in the form of a user interface on each of the network device to interact with the configuration of the management system and to receive reports and diagnostic information. The console is depicted in all three core components, as can be seen with reference to **Fig. 2** described below, but at any given moment it only resides on one system, according to user activation. This ensures that no conflicting configuration changes are made, which might have been the case if two consoles were operational at any given moment.

The Provisioner **12** automatically networks all of the workstations and network appliances that are physically connected to a network. The only thing that the user has to do is physically connect all the computers to the same physical network and install the network management software on one of the workstations. The workstation on which Provisioner **12** was installed becomes the temporary master or virtual MIS station of the home network, for the purpose of installing and provisioning the network.

Provisioner **12** probes all stations on the network, using low level broadcasts, to learn all the station names, verifies that the TCP/IP stack is installed on all stations (and if it is not installed, it remotely installs it) and configures the station IP addresses to enable home networking. This configuration depends on the type of devices connected to the network. In case a DHCP server is available (which is the common case) all network devices will be automatically configured to automatically receive their IP assignment from the DHCP server. But, in case a DHCP server is not available, the network management system will randomly assign a private IP to each network device and maintain a list of all existing IP stations. This will ensure that when a new device is discovered and DHCP is not used, it will be assigned a new unique IP address, to eliminate the possibility of addressing conflicts. Provisioner **12** further checks what kind of external devices are connected to each of the

workstations and automatically enables all networked computers to use these devices. One example for such a resource is an Internet connection. In this example, Provisioner **12** checks to see if at least one of the devices in the network is connected to the Internet, and automatically makes Internet connectivity available to all other devices. This is performed by the automatic installation of the correct Internet client using the user name and password that are used on the first PC that already has an Internet connection. Once again, it is important to note that all of these configurations do not require the user to perform any task or click any button – all of this is performed automatically and is transparent to the user. A second example is printing resources, where if a printer is connected to one of the devices, it will be made accessible through all the other devices without requiring any user configuration what so ever. In this way, Provisioner **12** automatically finds out what type of printer is connected to the device that has a printer and searches for the drivers for that printer in a variety of places (it will search on all network devices that are connected to the network as well as on the Internet if an Internet connection is available to at least one of the devices on the network. The search on the Internet is quite a complex task since Provisioner **12** executes it automatically without any user intervention. This automatic search is performed using commonly known automatic search technologies like the ones used by leading Internet search engines (Metacrawler, Google, Yahoo, AltaVista, etc.).

According to a further feature of the present invention the automatic search is followed by an automatic installation procedure, enabling activation of installation instructions as provided by hardware or software providers. This installation process provides complete and automatic setup and configuration execution for identified new hardware or software components.

As a default all resources are made available to all network devices and computer systems, but the system allows the user to block certain resources from specific PC's. For example, if the parents do not want to provide printer access to their son's PC, they can do so using the provisioning system. This is done using the graphical user interface of the console, which is explained below. There is no setup required for Provisioner **12**.

The Feeler **13** provides a live dynamic graphical network diagram of all workstations, resources and network appliances connected to the network, with their IP addresses, name on the network and a graphical display of the applications they are running in real time. Feeler **13** also counts the number of bytes and the bit per

second (bps) rate that each application used on each workstation. This functionality enables ISP's to use a billing structure to bill according to bandwidth used and/or the number of bytes transmitted. Feeler **13** can also be used to enable the user to check the billing that the ISP or phone/cable company is charging. Feeler **13** is also capable of keeping track of time of use for each application, for Application Service Provider (ASP) billing purposes or usage monitoring. As such, Feeler **13** has the capability of limiting the number of bytes or the bandwidth used by a specific application and a specific workstation or network appliance. In addition, Feeler **13** automatically discovers and identifies new network devices that are connected to the network, such as a new PC or any other network appliance, by triggering Provisioner **13** to install and provision the new devices into the home network.

Feeler **13** is a service running automatically on all devices in the network, gathering information on the amount of traffic and type of traffic being sent and received. Feeler **13** creates reports, both graphical and tabular, of specific information for specified time periods or intervals. These reports include (but are not limited to): Internet throughput; Type of traffic; Top talker; Top application; top application per talker; and number of print jobs per user. The user is able to view the report, print it, or export to other applications (such as Excel). The report is also saved as a file that can be reviewed later. There is no setup required for Feeler **13**. The user can get access to the report generation capabilities of the system through the graphical user interface as explained later on. The reports the Feeler generates can also be sent periodically to the Central Management Console at the service provider facilities in a format such as xml. This allows the service provider to perform all different type of statistical analysis based on the data received from thousands of home/SOHO networks and generate statistics reports of network activity and management.

The Healer **14** component finds and automatically fixes networking problems on the network, notifying the user that a problem has been discovered and how it was fixed. Healer **14** performs diagnostic tests using all stations on the network to gather the most complete picture of the situation of the network from the point of view of all network nodes. This information is used to provide an automatic fix for the problem. The automatic fix is performed using a variety of methods. For example, the system backs up the registry of all PC's on the network at any given moment so if the situation arises a reconstruction of a specific registry can be done. In other cases, the automatic fix will include the removal and re-installation of existing drivers

that might be corrupted. Furthermore, the system performs all diagnostic tests from all nodes on the network allowing quick elimination and isolation of problem. For example, if a cable is not securely in place the system will find the specific physical link that is down by performing mesh connectivity tests from all stations to all stations. If the system is not able to resolve an issue, Healer **14** uses knowledge from support web sites such as sites of Microsoft.com, the device manufacturer, a dedicated knowledge base support web site that is updated continuously with problems and their resolution etc. Healer **14** therefore incorporates a learning engine of resolution of networking problems. Healer is emulating the steps that a human MIS would do in such a case. The MIS would go to the Internet and try to look for a solution to the identified problem. This is exactly what Healer **14** would do using commonly known commercial technologies for automatic search on the Internet such as the ones used for business intelligence applications.

In addition, the present technology constantly monitors the operating system settings and configurations to ensure that at all times all users get the maximum bandwidth available from their broadband connection. The system constantly monitors the performance of the traffic to/from the Internet to see what type of utilization the user gets and ensure that he or she get the performance level that was agreed upon with the ISP. It also monitors and tests the performance of data transfer between the network devices themselves to ensure maximum bandwidth is available.

The healing process and diagnostics are able to discover a variety of network failures, including (but not limited to): cable from hub is not connected to one of the network devices; home network is not connected to the internet; printer is off; printer is out of paper; hub/router do not have power; degraded performance on link to isp; degraded performance within the home network.

Furthermore, the technology is unique in the sense that it is not a passive network management system. Rather, the home network system employs pro-active measures that constantly look for failures and upon detection, automatically fixes such failures. This is a self-healing process that the user is not aware of, unless he or she is interested in seeing reports that describe the failures and the actions taken to resolve them.

Fig. 2 is an illustration of the overall system architecture of the present invention on the network level, together with the system components. **Fig. 2** provides the network level depiction **20** of the autonomous network management

system. Each network device contains the floating agent and other three components of the system, as explained earlier.

Fig. 3a is an illustration of the service provider level system architecture 23 of the present invention, including the connection to thousands of home/SOHO network management systems as described in the previous figures. Each network device group contains the console, the floating agent and other three components of the system, as shown in **Fig. 2**.

Fig. 3b is another illustration of the service provider level, depicting how a single home/SOHO network management system is connected to the Centralized Management Console at the service provider's facilities 27.

General System Specifications

As explained, the user only needs to install the network management system on one workstation, and it subsequently installs itself on all other network appliances and workstations. Once the network is installed and provisioned, the system is de-centralized such that it can continue to work and display all information even when one of the PC's went down, even if the PC that was used for the installation went down.

For security purposes, the system requires a password for administrator access, to prevent certain users from accessing the management system and changing or viewing the configuration and settings. With this security password the non-qualified administrator (or administrators) of the home network, typically the parents, will be able to access the network management system from every workstation that is connected to the network.

The system supports all operating systems operating on all workstations and Internet devices/appliances. It is indifferent to the type of home network and supports all common types of home networks (or any other new types of home network technologies), such as: telephone wire based; Powerline wire based; Ethernet wire based; and wireless networks.

Graphical User Interface

The home network system can be represented as an icon on the O/S task bar, such that double clicking or right clicking on the icon opens a main menu

window. Alternatively, the system may be activated using menus, shortcuts or any other means.

The main window includes the following items (each is a link to another window):

1. Provisioner for setup and provisioning.
2. Feeler for reports generation.
3. Healer for fixing network problems and logging of diagnostics and problem resolution.
4. Network Map where the current dynamical graphical network map is depicted.

The user does not have to enter into any of these items, unless he/she is interested in changing any of the configurations or manually starting a process such as network fault diagnostics.

The following is a detailed description of a graphical user interface allowing control and management of the network management system. This description is an example, and does not limit the system to be controlled by any other graphical user interface as may be developed.

1. The Provisioner window includes two types of configuration:

i. Resources Discovery – a radio button with two options: automatic (which is the default setting) and manual. If manual is selected, a new button will appear which can refer to the function of "Discovering Resources". Clicking on this button starts the resource discovery process. The resource discovery process finds resources such as printers, Internet, zip drives, etc. that are connected to the network devices, and are therefore accessible by all the network devices. In addition, the Provisioner also finds new devices that are new to the network and automatically installs the Home Network Management system on these new devices, as well as provisions all of the resources.

ii. Provisioning – a radio button is provided with two options: automatic (which is the default) and manual. If manual is selected a new window will show a matrix of resources and devices connected to the network. Automatically all cells of the matrix are checked, but the user is able to uncheck some of the cells, in order to block access from a selected device to a selected resource. Double clicking or right clicking on a cell allows the user to configure a provisioning by time. For example, a certain PC can have access to the Internet only between 4pm and 6pm every day.

2. The Feeler window includes two selections:

i. Configuration – a list of all available reports is provided, with a check box next to each one. The default checks all the reports, but the user can uncheck selected reports. Furthermore, for each report there are two parameter definitions: total time of report; and sampling period. For example, a report can run for one month with a sample being taken once every hour on the hour.

ii. View report – this allows the user to view a report, print it, save it and export to Excel or another application.

3. The Healer window includes two items:

i. Configuration – allows the user to decide if all problems should be fixed automatically, or if the system should provide a "prompt" window telling the user that a problem was detected, along with the proposed method of fixing it, and waits for user's authorization to fix the problem. The user can also configure if he/she would like to save a healing log of all the problems discovered, their nature, the proposed fix and the actual fix performed.

ii. Healing Log – allows the user to view the healing log that includes all the problems discovered, their nature, the proposed fix and the actual fix performed.

The automatic configuration process according to the present invention:

The following method characterizes the setting up and operating of the network management system, according to a preferred embodiment of the present invention. **Fig. 4a** illustrates a process whereby a simple home network is autonomously set up for operation, according to a preferred embodiment of the present invention. As can be seen with regard to **Fig. 4a**, initially only PC1 **31** is connected to the Internet **32** and has access to the printer **33**. Initially, the Home Network Management software is installed on PC1 **31** only, and when PC2 **34** is physically connected to the network, the software is automatically installed on PC2 **34**. Upon completion of installation, PC2 **34** also becomes connected to the Internet **32**, and has access to printer **33** that is connected to PC1 **31**. The whole process is performed automatically without any user intervention.

The installation is completely automatic and does not require the user to insert a CD to additional PC's/devices connected to the network. It only requires an initial installation (using CD, downloading from the Internet etc.) of the home network management software on the first PC/network device. This initial installation thereby

enables a home (or other small) network to be created, wherein all the network devices that are subsequently automatically integrated into the network have Internet access, printer access, software application sharing, file sharing, as well as other resources available automatically to all PC's and network devices.

Fig. 4b illustrates a process whereby a simple network, wherein the Internet connection is through a computer which acts as the Internet gateway 35, is autonomously setup for operation according to a preferred embodiment of the present invention. In this network topology, one of the computers automatically detects the presences of direct connection to the Internet which can be established through a dial-up modem (for example), (during the resource provisioning discovery phase) and configures itself as an Internet Connection Sharing (ICS) server. Then the assigned computer communicates to the other computers in the network, to be configured as ICS clients.

The autonomous network management system described herein operates throughout the complete life cycle of the network **40**, as can be seen in **Fig. 5**, which illustrates the different phases in the life cycle of a typical home network, which the present invention supports. The autonomous management of the network is performed during the installation, configuration, provisioning and standard operation of the network. Furthermore, it includes pro-active monitoring of the network to allow automatic problem diagnostic and resolution. This ensures that problems are resolved before they start to affect the operation of the network as observed by the user.

The following is a detailed explanation of the operation of each of the components of the autonomous network management solution, including diagrams depicting the flow of events and actions automatically taken by the system.

Typical operation of the Provisioner on a new network device is as follows, as can be seen in **Fig. 6**, which is a flow chart illustrating the internal operation of the Provisioner, including its algorithm and event handler **50**. After installation **401** of the home network management system the Provisioner sends a broadcast to all network devices; asking the devices to identify themselves.

In receiving replies from devices/stations, the Provisioner checks whether one of the replies is identified as a current master. If there is no master, the device upon which the Installation occurred becomes the master and goes into master mode. If

there is another master, this means that the network management system is already installed on this network.

The new device goes into slave mode, and in turn is updated by the master. The new device also chooses a random priority number, which is used to determine the new master if no current master is found at any time. The master selection process includes the advertising of the priority number by all network devices. The one with the highest priority number changes its mode to become the master.

The master device checks whether prior network information exists, defining network activity, available resources, network devices, history etc. If no prior information exists the master device builds a database of all stations including their name and IP address. It then sends the correct installation applet to all slave stations, depending on the operating system of the slave system.

Then the master requests from all slave stations a list of the resources available to them and updates the database to include all resources connected and available to each station. If the station information already exists, the master sends a status check to all devices in the database/information/history, to ensure that all stations are running and to update the database with the up-to-date status of each device. It is the task of the master device to maintain the network database, as well as updating the software on all devices and maintaining updated records of the status of all devices. The master device updates any station without updated resources. This whole process is continuously repeated to ensure that at all times the database of stations and resources is available and updated to reflect the current situation.

Fig. 7 is a flow chart illustrating the internal operation of the Feeler including its algorithm and event handler **60**. Typical operation of the Feeler is as follows, as can be seen in **Fig. 7.** After installation of the autonomous network management system on a network device, the Feeler gets updated network information (in the form of a database, as explained earlier) from the master device.

The feeler then gathers information about applications running on the particular device/station on which the network management software was installed. This is done concurrently on all network devices, since all of them have the floating agent installed on them, as a result of the operation of the Provisioner.

The Feeler now checks availability of all the device's resources. If any of the resources is not available, the Healer is launched. If availability of all resources is confirmed, connectivity of the device to all other stations is checked. If connectivity

to any of the other stations is not okay, the Healer is launched. If full mesh connectivity is confirmed, the Feeler enters the next phase of testing for performance.

The Feeler checks Internet connection bandwidth for the specific network device. If the bandwidth is not optimized, the Healer is launched. The device periodically verifies whether it is the master device or not. If it is not the master, it waits to receive network information from the master, and continuously monitors the network in terms of resource availability, connectivity and performance as explained above. If the device is the master, the device updates and maintains the network database with application information for each network device. In addition, it builds a graphical display of the network, and creates system reports so that they are readily available should the user require them.

Figs. 8a and **8b** are flow charts illustrating the internal operation of the Healer including its algorithm and event handler **70**. Typical operation of the Healer is as follows, as can be seen in **Figs. 8a** and **8b.** The Healer enables devices in the network to optimize availability, connectivity and bandwidth. The Healer uses a database to store updated information for diagnosing and fixing problems. Alternatively, the Healer connects to an Internet based resource center in order to find possible resolutions for the current problem. If a solution cannot be found for a problem, the Healer notifies the user with a detailed description of the network components that failed and the meaning of the failure.

Operation of the Healer is triggered by the Feeler, and the reason for its invocation controls its operation. If the Healer is triggered because of a resource availability problem, it immediately checks to see if this resource is directly connected to the network device or available through the network. If it is a resource directly connected then it starts the specific resource virtual troubleshooter, which automatically operates available troubleshooters on the operating system or device.

It also connects to the support Web site of the specific device and finds the resolution for the problem detected. It tries to solve the problem in a variety of ways until it is successful. When the problem is resolved it updates all stations that the resource is available again. If it fails to resolve the problem, it notifies the user that the problem cannot be resolved automatically and requires escalation into a remote support application or requires a professional network technician. If the resource that is not available is not directly connected to the network device, but rather used to be available through the network (i.e. a printer connected to another computer on the

network), the Healer communicates with the network device that has a direct connection to the resource.

It probes it to understand if the resource availability problem also affects the network device with the direct connection. If this is not the case, the Healer is triggered with a connectivity problem. If the problem persists with the directly connected network device, the Healer verifies that the Healer was started on the network device with the direct connection and awaits resolution of the problem. If a resolution is not indicated within a limited time it sends an indication to the user that the problem cannot be resolved automatically, which might indicate that the remote station with the direct connection to the device is not operational.

If the Healer is triggered with a connectivity problem, it sends an automatic request to all other devices to perform a connectivity test and report back. If the problem persists for all stations, and all of them cannot communicate with a specific station, it notifies the user that either the cable to the specific system is not secured or that this specific system is down. It also updates the Provisioner on the master so that the network information database is updated. If the problem persists on more than one of the links of the specific network device, which triggered its Healer, it tries to restore the network configuration to a previous working configuration to check if the problem is resolved. If it is resolved, the log is updated, and if not the user is notified that either the cable is not connected, or there is a hardware malfunction with its network interface card.

If the Healer is triggered with a bandwidth optimization problem, it first requests all other stations to perform bandwidth tests and report back. If the problem persists with all stations it tries to restore the networking configuration of the router and/or modem and/or residential gateway to a previous working one. If this resolves the problem, the log is updated, but if not the user is notified that the problem is external to the home network and requires the intervention of the Internet Service Provider or hardware manufacturer. If the bandwidth optimization problem is not persistent with all stations on the home network, the Healer tries to restore its own networking configuration to a previously working one. If this resolves the problem, the log is updated. But, if the problem is not resolved, the user is notified that a problem internal to the home network has occurred, and it cannot be restored automatically.

If the Healer is triggered, but the problem is other than resource availability, connectivity, or a bandwidth optimization problem, then the Healer connects to a dedicated support Web site. It then searches through the knowledge base to see if a

resolution to the specific problem as identified exists. If a solution is found, it employs it, and checks to see that the problem disappeared. If it was resolved the log is updated, but if not, the user is notified of a problem that cannot be resolved automatically, and requires the intervention of a remote support technician.

Healer **14**, according to a hierarchal logic flow, first tries to fix the problem using the resources of the malfunctioning device itself. In case the problem remains unsolved Healer 14 tries to use resources of other network devices. At the next stage Healer 14 accesses remote resources, such as designated sites relating to network maintenance or a Web-site of a specific provider. And, the last stage in this "software based escalation procedure" is providing a simultaneous alert for the home/SOHO network user and for the service provider on the Central Management Console that enables the user to allow a remote technician to perform remote diagnostics and troubleshooting of the problem (See Fig. **8c**).

Fig. 9a is a flow chart illustrating the algorithm of the Driver Search Agent (DSA) 80 that automatically searches for a specific driver suitable for a specific operating system, downloads it, and installs it in order to fix a printing problem. This is an exemplary, simplified Driver Search Agent algorithm that only looks for a printer driver on hp.com. The same type of algorithm is used for automatically finding drivers for other printers as well as for other resources such as scanners, digital cameras, TV's, refrigerators and any other type of computer peripherals and network appliance.

Fig. 9b is a continuation 85 of the flow chart of **Fig. 9a**.

Fig. 10 is a flow chart illustrating the algorithm used in the discovery of new systems in the network 90. It shows how ICMP "ping" is used to scan the range of applicable IP addresses in the search for new stations. The discovery of new stations connected to the network on which, the Floating Manager is not installed is performed by sending an ICMP echo request message to known IP address ranges: the default IP range is 169.254.xx.xx, the ICS range is 192.168.0.xx, the IP range of the router / residential gateway if one exists on the network.

Fig. 11 is a flow chart illustrating the algorithm used when the system is launched and it provisions itself for operation in the network 100. It emphasizes the

self-decision making capabilities of the system. It will configure its IP address differently depending on the situation of the network. This will enable the computers in the network to communicate with each other and automatically create the network, regardless of the physical network topology. For example, each computer will configure itself differently depending on the network topology – if there is a router or residential gateway that is offering DHCP services then the computers will configure themselves as DHCP clients. But, if there is no router and one of the computers is connected to the Internet through a dialup modem connection (as an example) then the computers will configure themselves as an ICS clients and get their IP address from the ICS server. If no Internet connection exists, then the master Floating Manager is assigned as a DHCP server and will provide IP addresses to all other computes.

ALTERNATE EMBODIMENTS

Several other embodiments are contemplated by the inventors. The described system and architecture can be used in the SOHO (Small Office Home Office) environment to eliminate the need to call for professional help every time a new network component needs to be added or when the network malfunctions. Furthermore, an extension to the current invention can include remote management, remote troubleshooting, remote updates etc. A service provider or system integrator providing home network management and maintenance service to the consumer can also remotely manage the autonomous system described so far. The central office of the service provider will have a server application that can automatically communicate with the autonomous network management system at the home, retrieve information and change its configurations.

Moreover, the autonomous network management system gathers and maintains all information about the traffic running on the network. This allows a Service Provider (Internet Service Provider and/or Application Service Provider) to retrieve this information remotely and bill the consumer based on usages, type of application and bandwidth used for a specific application.

Another use of this invention is to provide the communication service providers with a platform for additional services such as bandwidth on demand (user being offered a temporary upgrade in the bandwidth from the ISP for additional money so that he can download a file faster), remote updates of drivers, application software and more, remote troubleshooting, content distribution to the specific PC on

the home network and more. The system described in this invention acts as the interface between the customer premises (home or SOHO) and the service provider call center or central office. This interface allows the bi-directional exchange of information for management, control and other types of operations.

The foregoing description of the embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. It should be appreciated that many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention be limited not by this detailed description, but rather by the claims appended hereto.

We Claim:

1. A system for autonomous management of a small network comprising a plurality of devices using distributed network management techniques and algorithms that cover the whole life cycle of the network, the system comprising:

a floating manager, which resides on and controls all network components, wherein only one of these floating managers is the master actually managing the system at any given time, and wherein any of the floating managers on the network can be assigned as the master at any given time not affecting the system operation;

a provisioner for dynamic setup and configuration of the network components;

a feeler for monitoring network activity and report generation; and

a healer for automatically identifying, analyzing, diagnosing, troubleshooting and resolving network problems, and for logging of diagnostics and problem resolution,

wherein such management is executed automatically for all network devices.

2. The system according to claim 1, wherein the floating manager installs itself, and all other required components of the network management system, on any new device that is discovered on the network.

3. The system according to claim 1, wherein the healer comprises a window comprising:

a configuration, which allows the user to decide if all problems should be fixed automatically; and

a healing log, which allows the user to view the healing log that includes all the problems discovered.

4. The system according to claim 1, wherein the system management is based on continuous information exchange between the floating mangers of all network components.

5. The system according to claim 1, wherein the provisioner comprises a window comprising two types of configuration:

resources discovery having a radio button with two options: automatic (which is the default setting) and manual; and

provisioning having a radio button with two options: automatic (which is the default); and manual.

6. The system according to claim 1, wherein the provisioner monitors the introduction of new hardware components or software applications, and automatically updates the configuration of all network components for communicating and sharing with said new ~~hardware components or software applications, wherein the update is~~ based on local or remote resources of configuration data.

7. The system according to claim 6, further comprising an automatic installation module for searching installation procedures for new hardware or software components and applying identified installation procedures for complete setup and configuration of new hardware/software components.

8. The system according to claim 1, wherein the feeler detects all applications of each network component, checks the availability of all device resources and checks connectivity between all network components.

9. The system according to claim 1, wherein the healer is triggered if network resources are unavailable to one or more network components, or if any of the network components fail to communicate.

10. The system according to claim 1, wherein the feeler further detects band width optimization for all network components triggering the healer in case the band width connection is less than optimum.

11. The system according to claim 1, wherein the healer is an expert system for networking trouble shouting, which acts as the virtual MIS of the network, based on automatic diagnostics and isolation of malfunctions as monitored by the feeler, enabling repair of

network problems, in accordance with a knowledge base of network configurations and available troubleshooting procedures.

12. The system according to claim 1, further enabling remote management and access from a Central Management Console located at an external site, in order to remotely monitor, update and control network management and troubleshooting utilizing the system components wherein said Central Management Console controls plurality of autonomous small networks.

13. The system according to claim 1, wherein the system requires a password for administrator access, to prevent certain users from accessing the management system and changing/viewing the configuration and settings.

14. The system according to claim 1, wherein the master floating manager is selected according to pre-determined priority.

15. A method for autonomous management of a small network comprising a plurality of devices using distributed network management techniques and algorithms that cover the whole life cycle of the network, the method comprising:

installation of the network by a floating manger component of the network;

provisioning and setup of the network by a provisioner application of the network;

detecting new network component and resources and installing management applications on each detected device wherein the management application include healer, feeler , provisioner;

monitoring of network activity by a feeler application of the network;

reporting and triggering of malfunctions of network activity by a feeler application of the network;

troubleshooting network malfunctions by a healer application of the network;

measuring network activity performance; and

managing and updating network maintenance.

16. The method of claim 15 wherein the floating manger, provisioner application, feeler application, and healer application are automatically self installed on every network component.

17. The method of claim 15 wherein at any given time only one master floating manger controls network management.

18. The method of claim 17 wherein the master floating manager is selected according to predetermined priority.

19. The method according to claim 15, wherein provisioning further comprises:

probing all stations on the network, using low level broadcasts, to learn all the station names;

verifying that the TCP/IP stack is installed on all stations;

remotely installing the TCP/IP stack, if necessary; and

configuring the station IP addresses to enable home networking.

20. The method according to claim 15, wherein provisioning comprises detection of new hardware components and updating configuration of all network components for communicating with said new hardware components.

21. The method according to claim 20 further comprising enabling automatic installation, wherein automatic installation comprises the steps: of searching installation procedures for new hardware or software components; and applying identified installation procedures for complete setup and configuration of new hardware/software components.

22. The method according to claim 15, wherein monitoring comprises: checking network connectivity, checking availability of network resources; and checking communication bandwidth optimization.

23. The method according to claim 15, wherein trouble shooting comprises analyzing a reported problem source and fixing the problem

source in accordance with configuration data, utilizing known troubleshooting procedures.

24. The method of claim 15 further comprising the step managing and controlling plurality of autonomous small networks utilizing the network internal applications, wherein said managing is controlled by one external management application located at remote server.

25. The method of claim 15 wherein the troubleshooting procedure is based on predefined rules determining the order of handling reported problem .

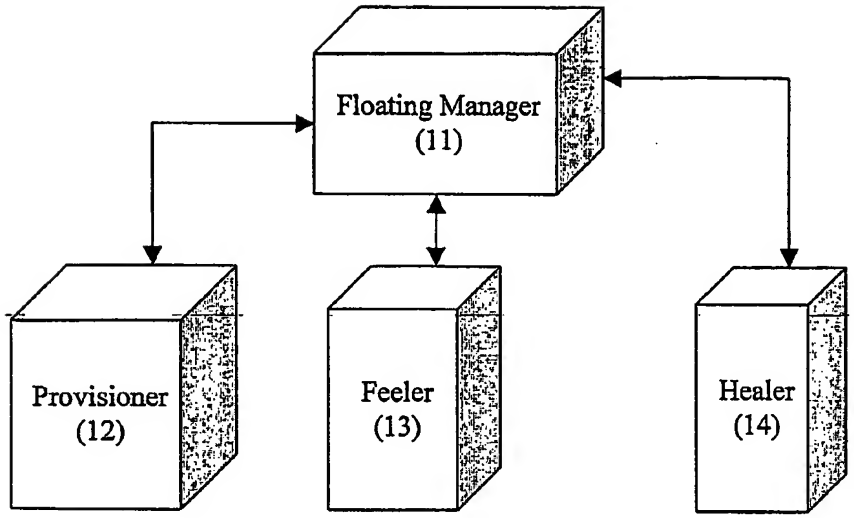
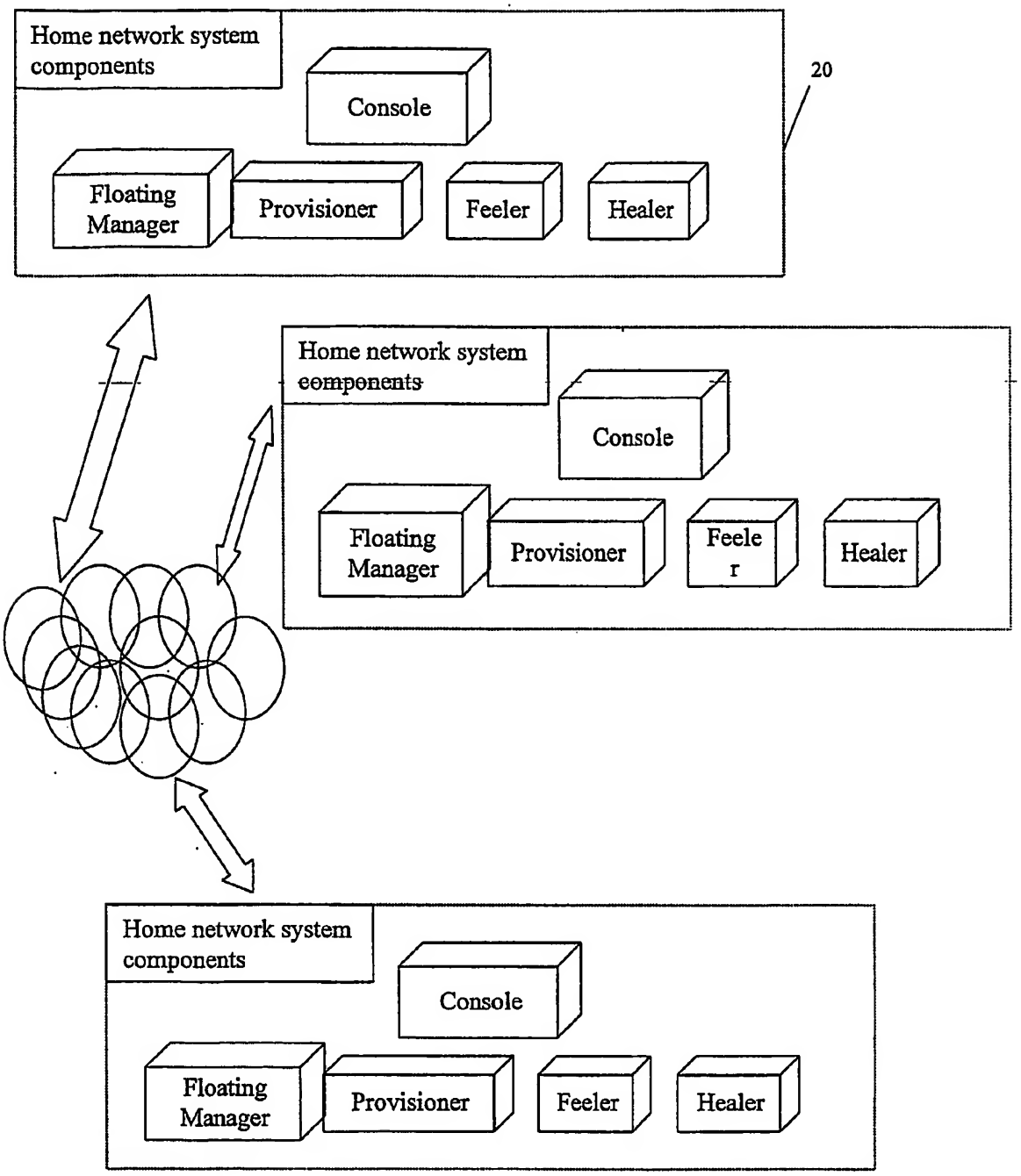


Fig. 1


Home network system components
Console
20
Floating Manager
Provisioner
Feeler
Healer
Home network system components
Console
Floating Manager
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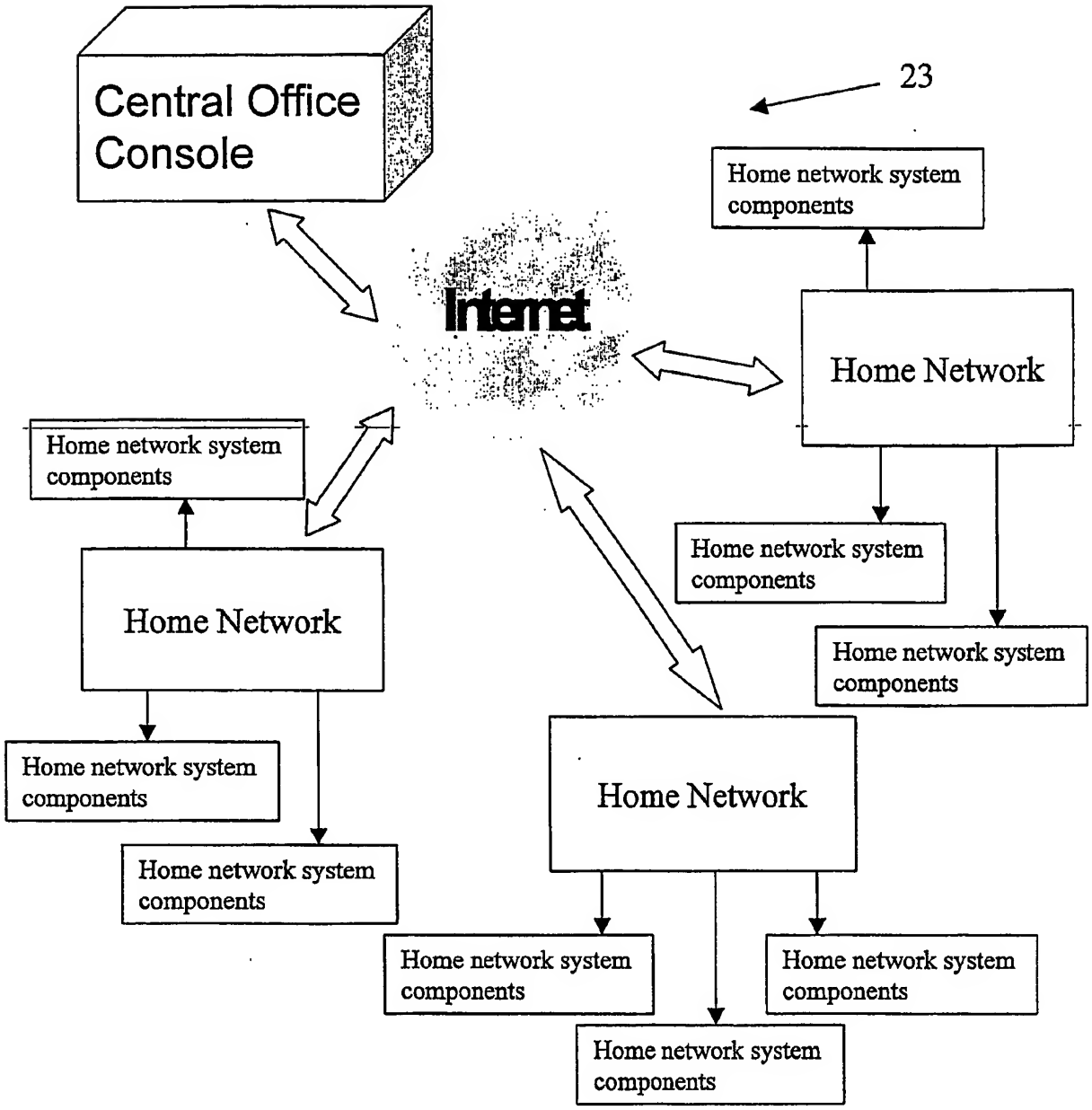
Healer
Home network system components
Console
Floating Manager
Provisioner
Feeler
Healer

Fig. 2


Central Office Console
23
Home network system components
Internet
Home Network
Home network system components
Home Network
Home network system components
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Home Network
Home network system components
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Home network system components
Home network system components

Fig. 3a

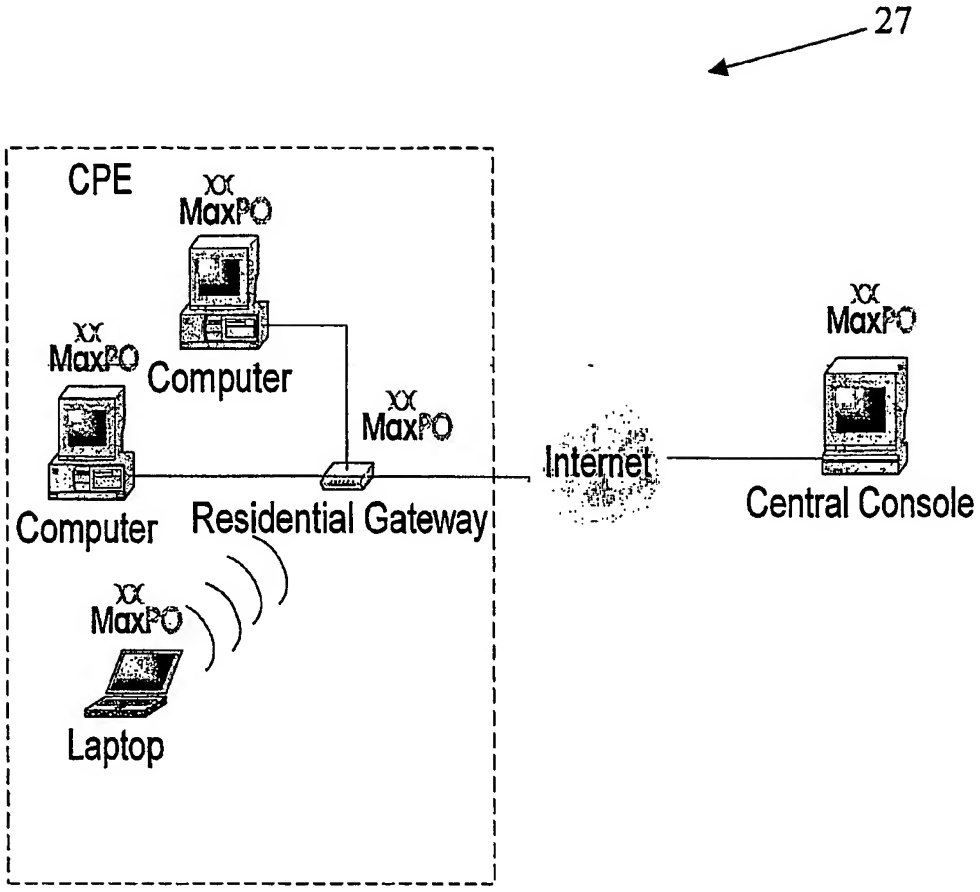

27
CPE
MaxPO
Computer
MaxPO
MaxPO
Computer
MaxPO
Residential Gateway
MaxPO
Laptop
Internet
MaxPO
Central Console

Fig. 3b

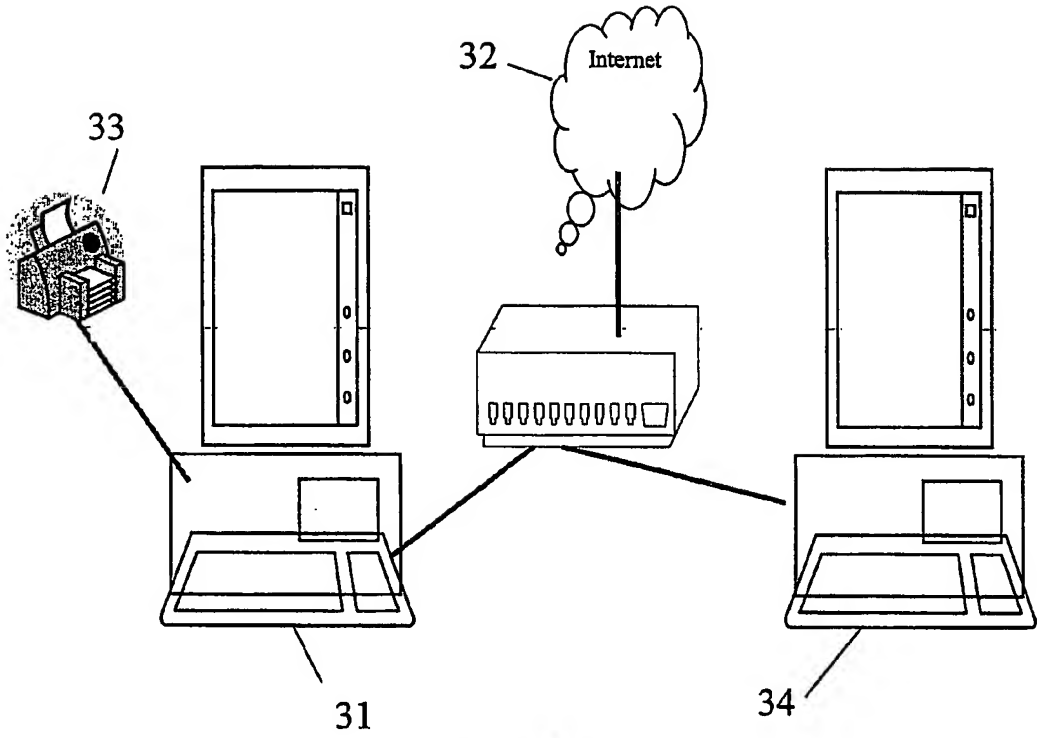
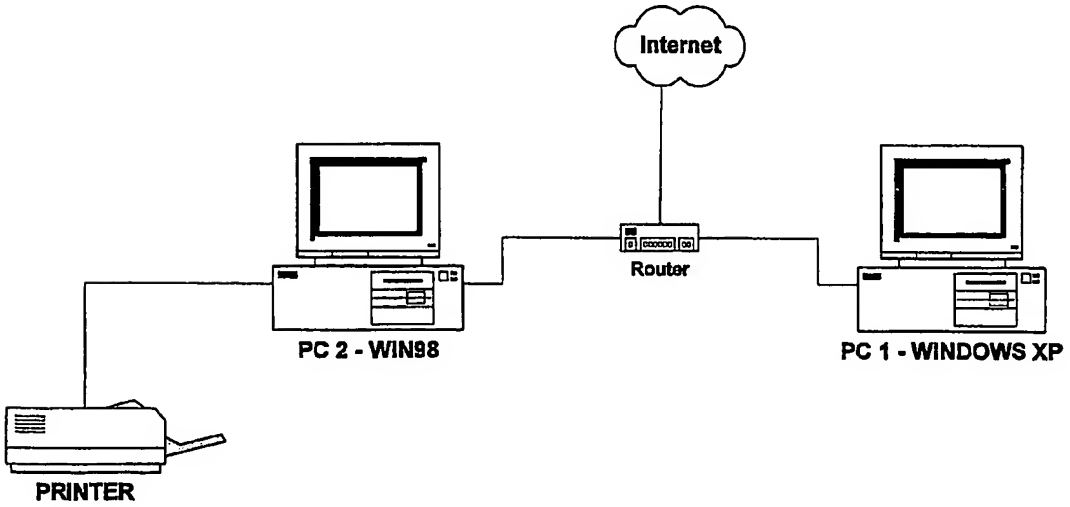

32
Internet
33
31
34

Fig. 4a


Internet
Router
PC 2 - WIN98
PC 1 - WINDOWS XP
PRINTER

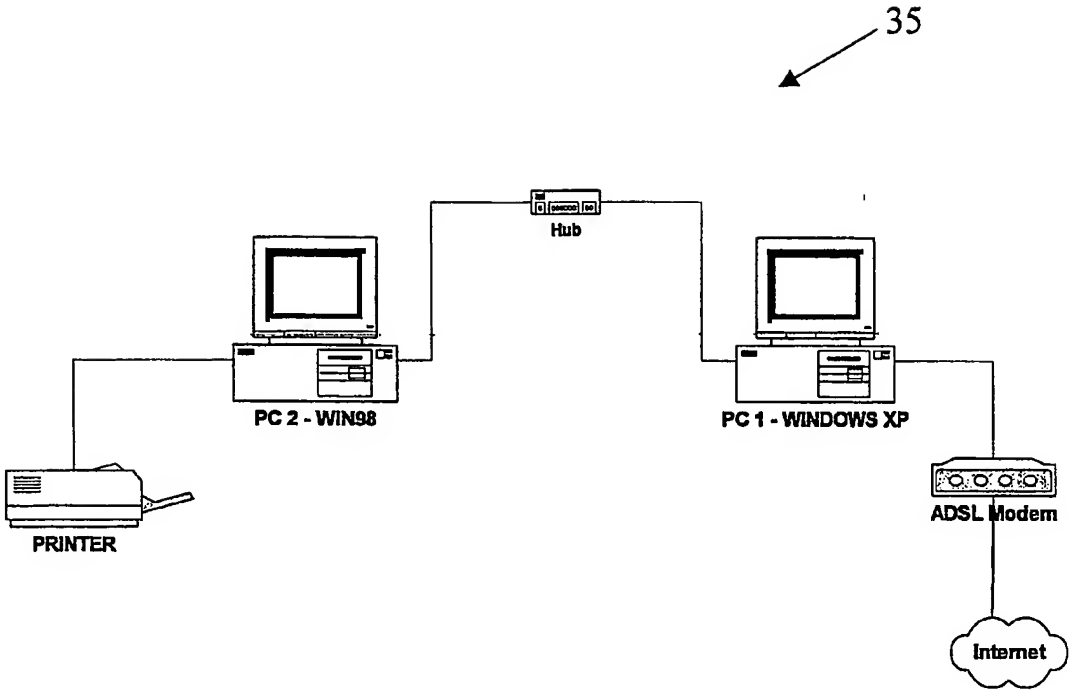


Fig. 4b

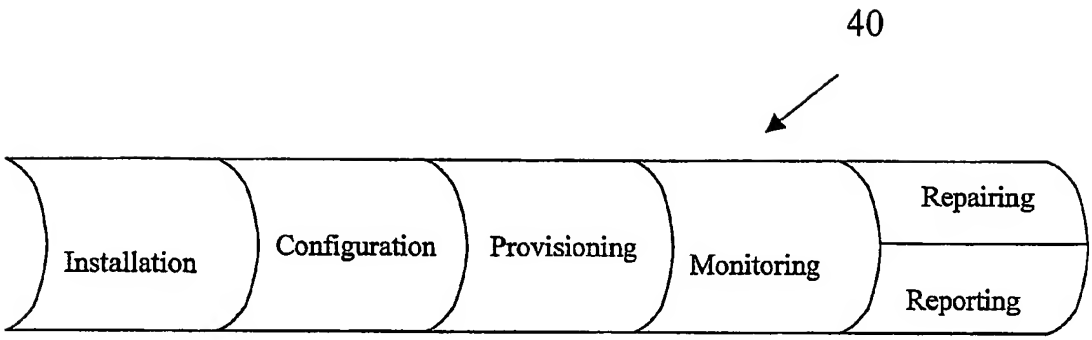

40
Installation
Configuration
Provisioning
Monitoring
Repairing
Reporting

Fig. 5

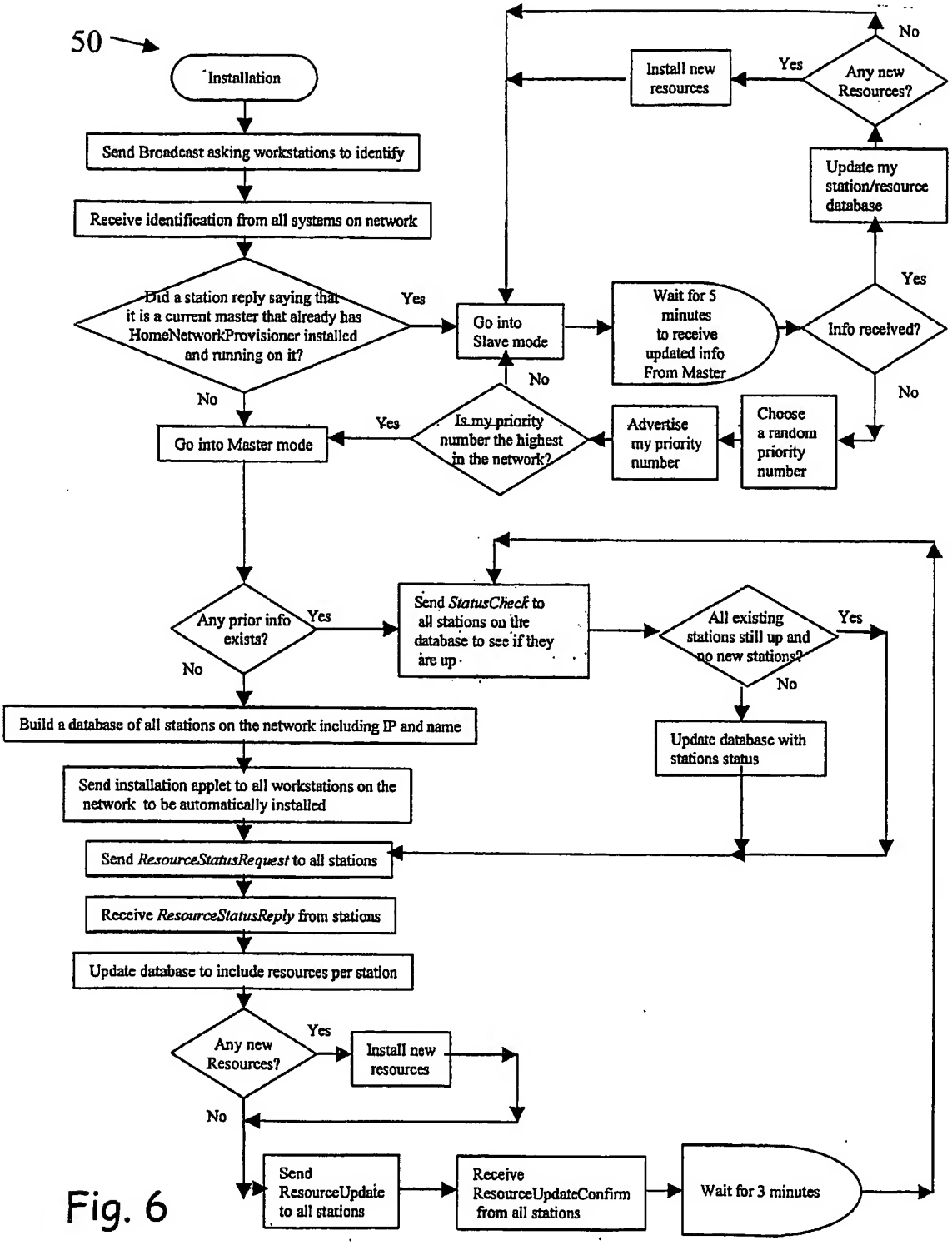

50
Installation
Send Broadcast asking workstations to identify
Receive identification from all systems on network
Did a station reply saying that it is a current master that already has HomeNetworkProvisioner installed and running on it?
Yes
No
Go into Slave mode
Wait for 5 minutes to receive updated info From Master
Info received?
Yes
No
Update my station/resource database
Any new Resources?
Yes
No
Install new resources
Go into Master mode
Is my priority number the highest in the network?
Yes
No
Advertise my priority number
Choose a random priority number
Any prior info exists?
Yes
No
Send StatusCheck to all stations on the database to see if they are up
All existing stations still up and no new stations?
Yes
No
Update database with stations status
Build a database of all stations on the network including IP and name
Send installation applet to all workstations on the network to be automatically installed
Send ResourceStatusRequest to all stations
Receive ResourceStatusReply from stations
Update database to include resources per station
Any new Resources?
Yes
No
Install new resources
Send ResourceUpdate to all stations
Receive ResourceUpdateConfirm from all stations
Wait for 3 minutes

Fig. 6

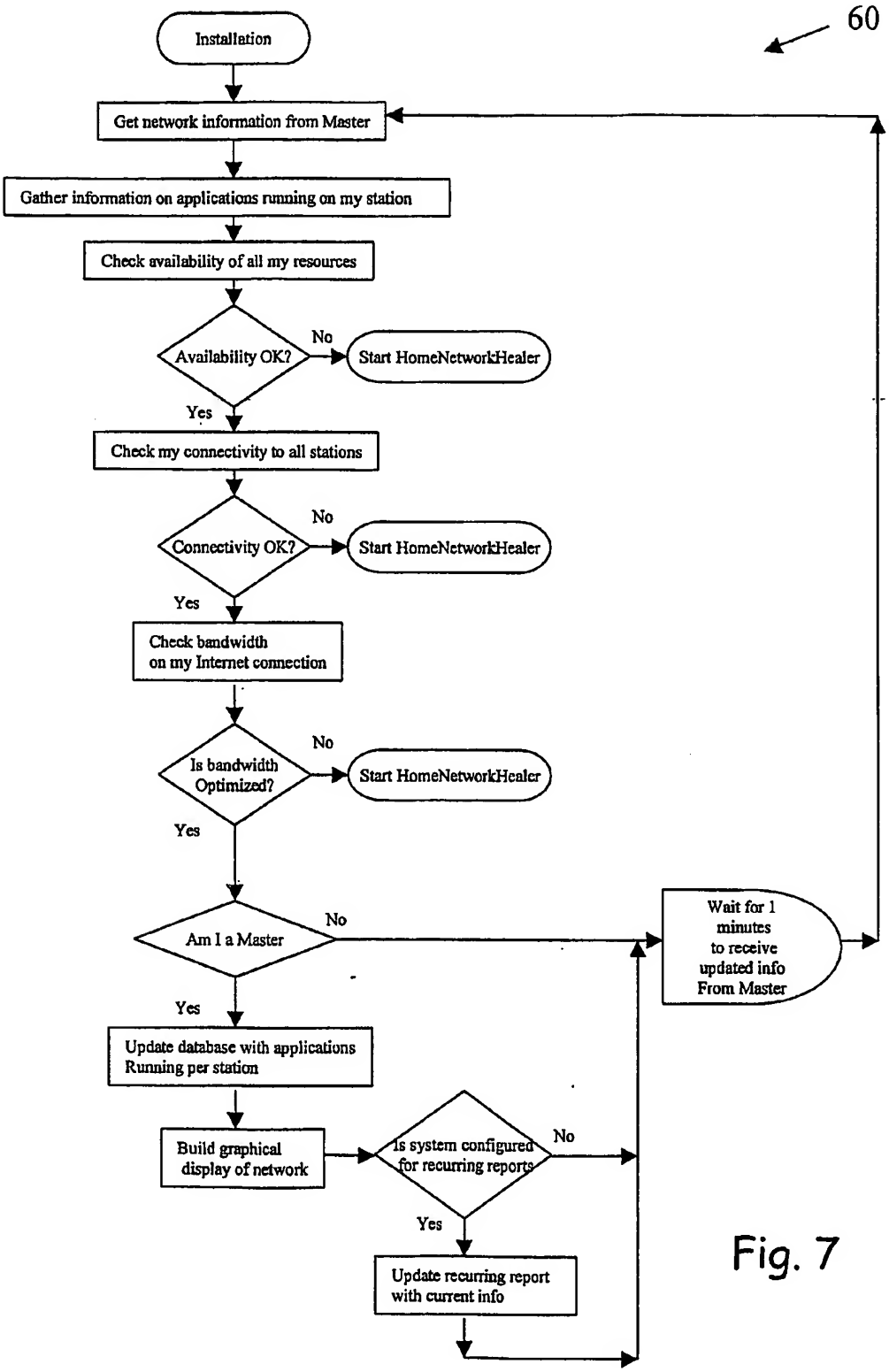

60
Installation
Get network information from Master
Gather information on applications running on my station
Check availability of all my resources
Availability OK?
No
Start HomeNetworkHealer
Yes
Check my connectivity to all stations
Connectivity OK?
No
Start HomeNetworkHealer
Yes
Check bandwidth on my Internet connection
Is bandwidth Optimized?
No
Start HomeNetworkHealer
Yes
Am I a Master
No
Wait for 1 minutes to receive updated info From Master
Yes
Update database with applications Running per station
Build graphical display of network
Is system configured for recurring reports
No
Yes
Update recurring report with current info

Fig. 7

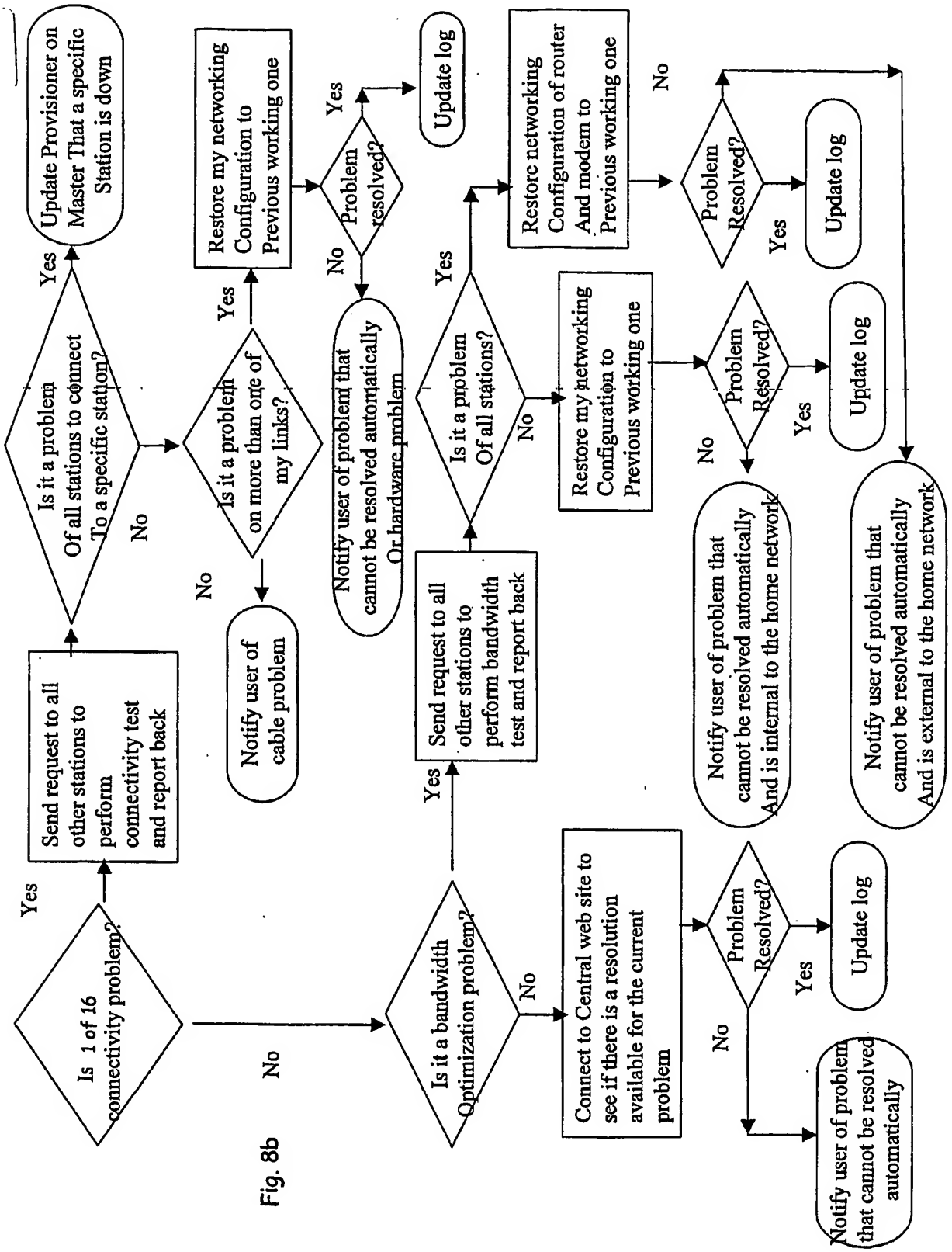

Is 1 of 16 connectivity problem?
Yes
No
Send request to all other stations to perform connectivity test and report back
Is it a problem Of all stations to connect To a specific station?
Yes
No
Update Provisioner on Master That a specific Station is down
Is it a problem on more than one of my links?
Yes
No
Restore my networking Configuration to Previous working one
Problem resolved?
Yes
No
Update log
Notify user of problem that cannot be resolved automatically Or hardware problem
Notify user of cable problem
Is it a bandwidth Optimization problem?
Yes
No
Send request to all other stations to perform bandwidth test and report back
Is it a problem Of all stations?
Yes
No
Restore networking Configuration of router And modem to Previous working one
Restore my networking Configuration to Previous working one
Connect to Central web site to see if there is a resolution available for the current problem
Problem Resolved?
Yes
No
Update log
Notify user of problem that cannot be resolved automatically And is internal to the home network
Notify user of problem that cannot be resolved automatically
Problem Resolved?
Yes
No
Update log
Notify user of problem that cannot be resolved automatically And is external to the home network

Fig. 8b

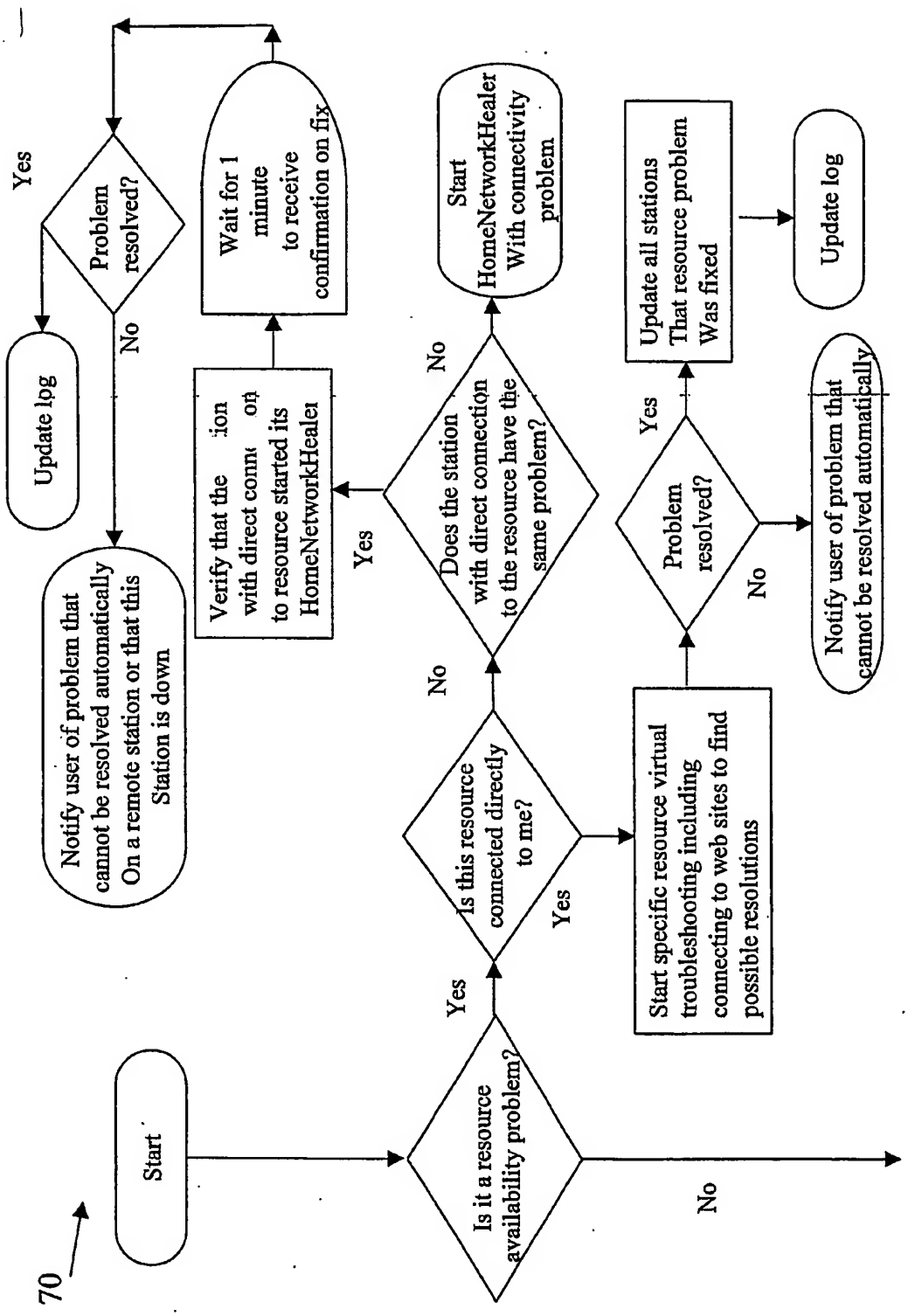

70
Start
Is it a resource availability problem?
Yes
No
Is this resource connected directly to me?
Yes
No
Start specific resource virtual troubleshooting including connecting to web sites to find possible resolutions
Problem resolved?
Yes
No
Update all stations That resource problem Was fixed
Update log
Notify user of problem that cannot be resolved automatically
Does the station with direct connection to the resource have the same problem?
Yes
No
Start HomeNetworkHealer With connectivity problem
Verify that the ion with direct conn on to resource started its HomeNetworkHealer
Wait for 1 minute to receive confirmation on fix
Problem resolved?
Yes
No
Update log
Notify user of problem that cannot be resolved automatically On a remote station or that this Station is down

Fig. 8a

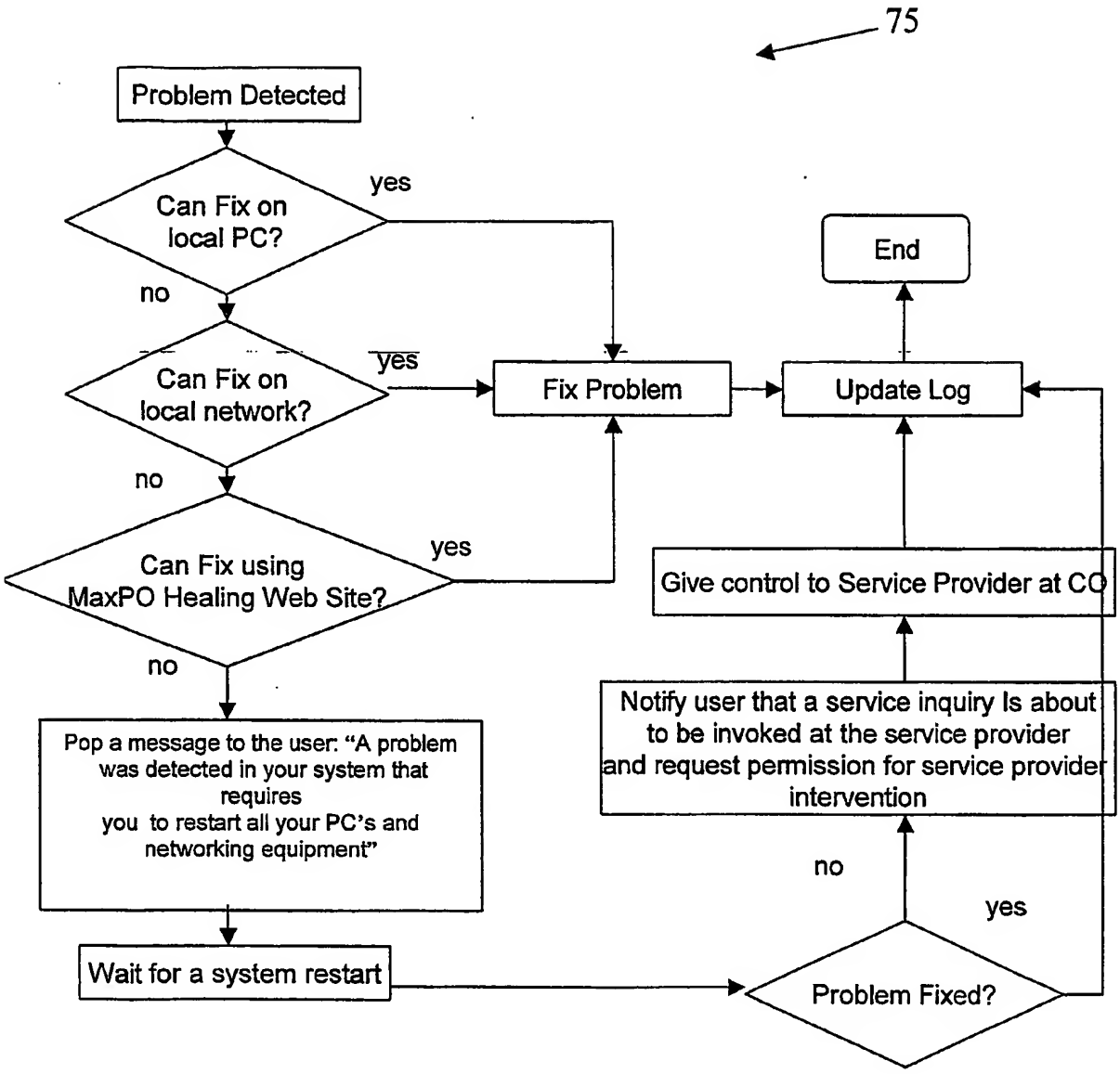

75
Problem Detected
Can Fix on local PC?
yes
no
Can Fix on local network?
yes
no
Can Fix using MaxPO Healing Web Site?
yes
no
Pop a message to the user: "A problem was detected in your system that requires you to restart all your PC's and networking equipment"
Wait for a system restart
Fix Problem
End
Update Log
Give control to Service Provider at CO
Notify user that a service inquiry Is about to be invoked at the service provider and request permission for service provider intervention
no
yes
Problem Fixed?

Fig. 8c

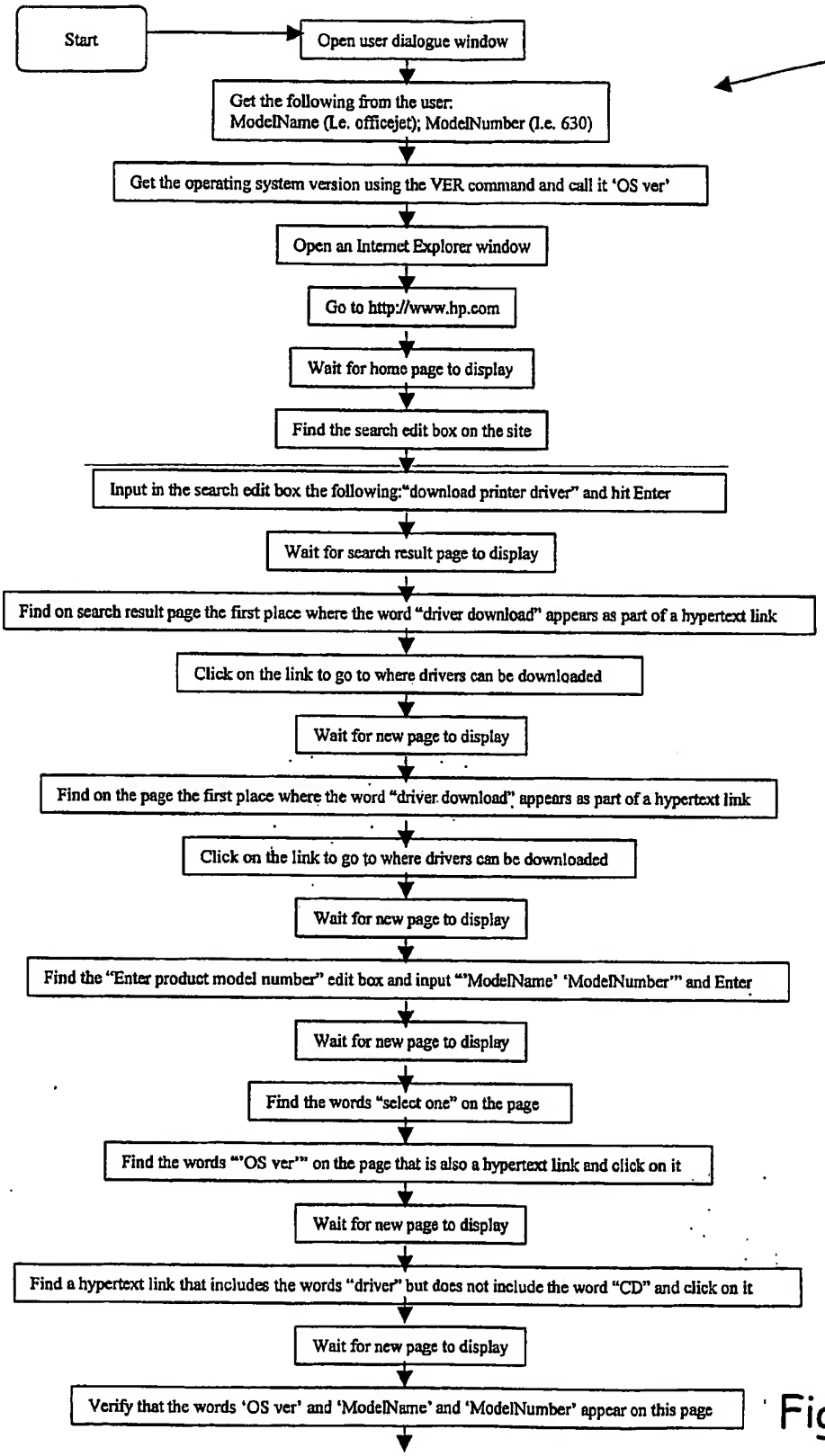

Start
Open user dialogue window
80
Get the following from the user:
ModelName (I.e. officejet); ModelNumber (I.e. 630)
Get the operating system version using the VER command and call it 'OS ver'
Open an Internet Explorer window
Go to http://www.hp.com
Wait for home page to display
Find the search edit box on the site
Input in the search edit box the following:"download printer driver" and hit Enter
Wait for search result page to display
Find on search result page the first place where the word "driver download" appears as part of a hypertext link
Click on the link to go to where drivers can be downloaded
Wait for new page to display
Find on the page the first place where the word "driver download" appears as part of a hypertext link
Click on the link to go to where drivers can be downloaded
Wait for new page to display
Find the "Enter product model number" edit box and input ""ModelName' 'ModelNumber"" and Enter
Wait for new page to display
Find the words "select one" on the page
Find the words "'OS ver'" on the page that is also a hypertext link and click on it
Wait for new page to display
Find a hypertext link that includes the words "driver" but does not include the word "CD" and click on it
Wait for new page to display
Verify that the words 'OS ver' and 'ModelName' and 'ModelNumber' appear on this page

Fig. 9a

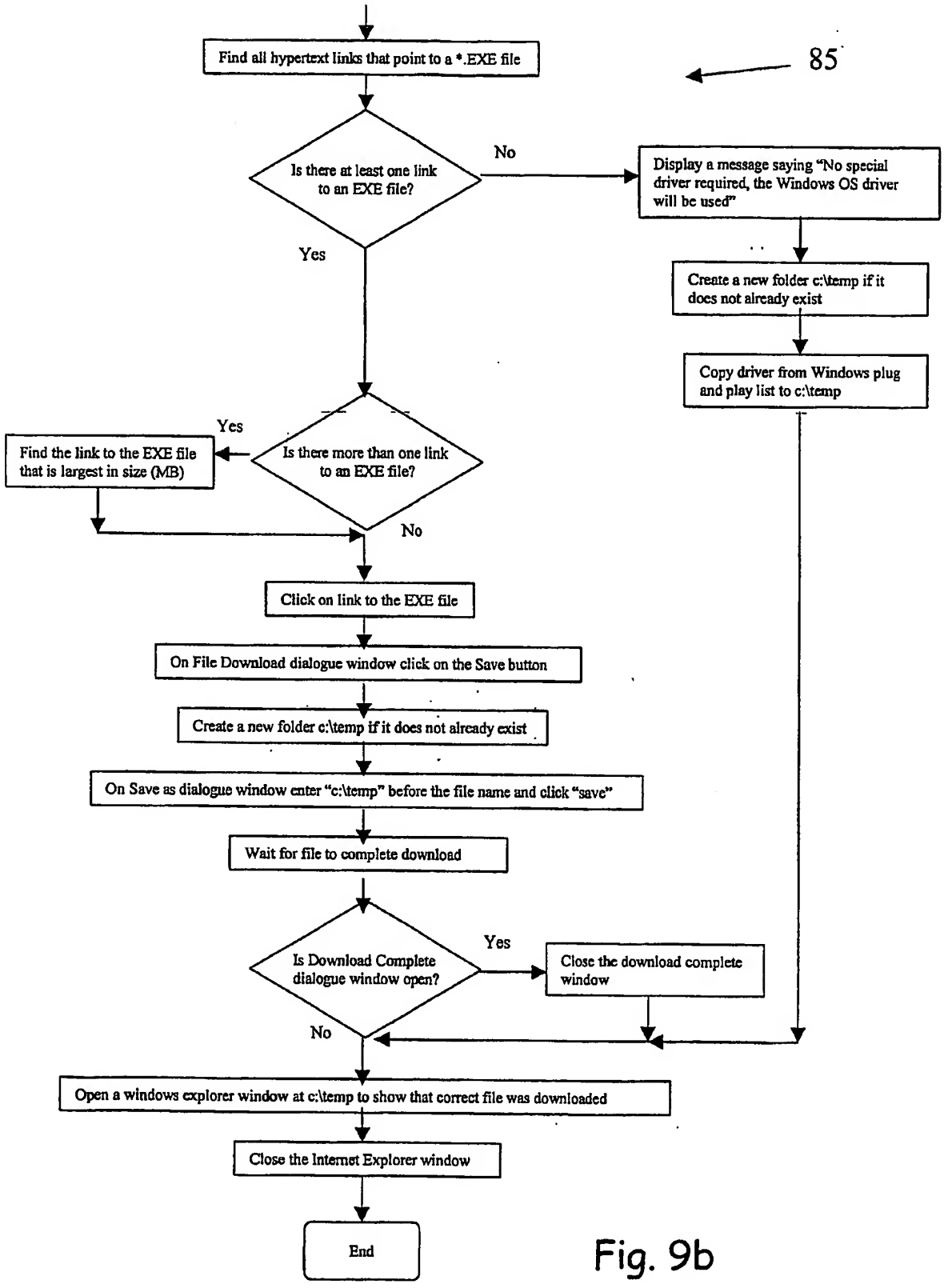

Find all hypertext links that point to a *.EXE file
85
Is there at least one link to an EXE file?
No
Display a message saying "No special driver required, the Windows OS driver will be used"
Yes
Create a new folder c:\temp if it does not already exist
Copy driver from Windows plug and play list to c:\temp
Yes
Find the link to the EXE file that is largest in size (MB)
Is there more than one link to an EXE file?
No
Click on link to the EXE file
On File Download dialogue window click on the Save button
Create a new folder c:\temp if it does not already exist
On Save as dialogue window enter "c:\temp" before the file name and click "save"
Wait for file to complete download
Is Download Complete dialogue window open?
Yes
Close the download complete window
No
Open a windows explorer window at c:\temp to show that correct file was downloaded
Close the Internet Explorer window
End

Fig. 9b

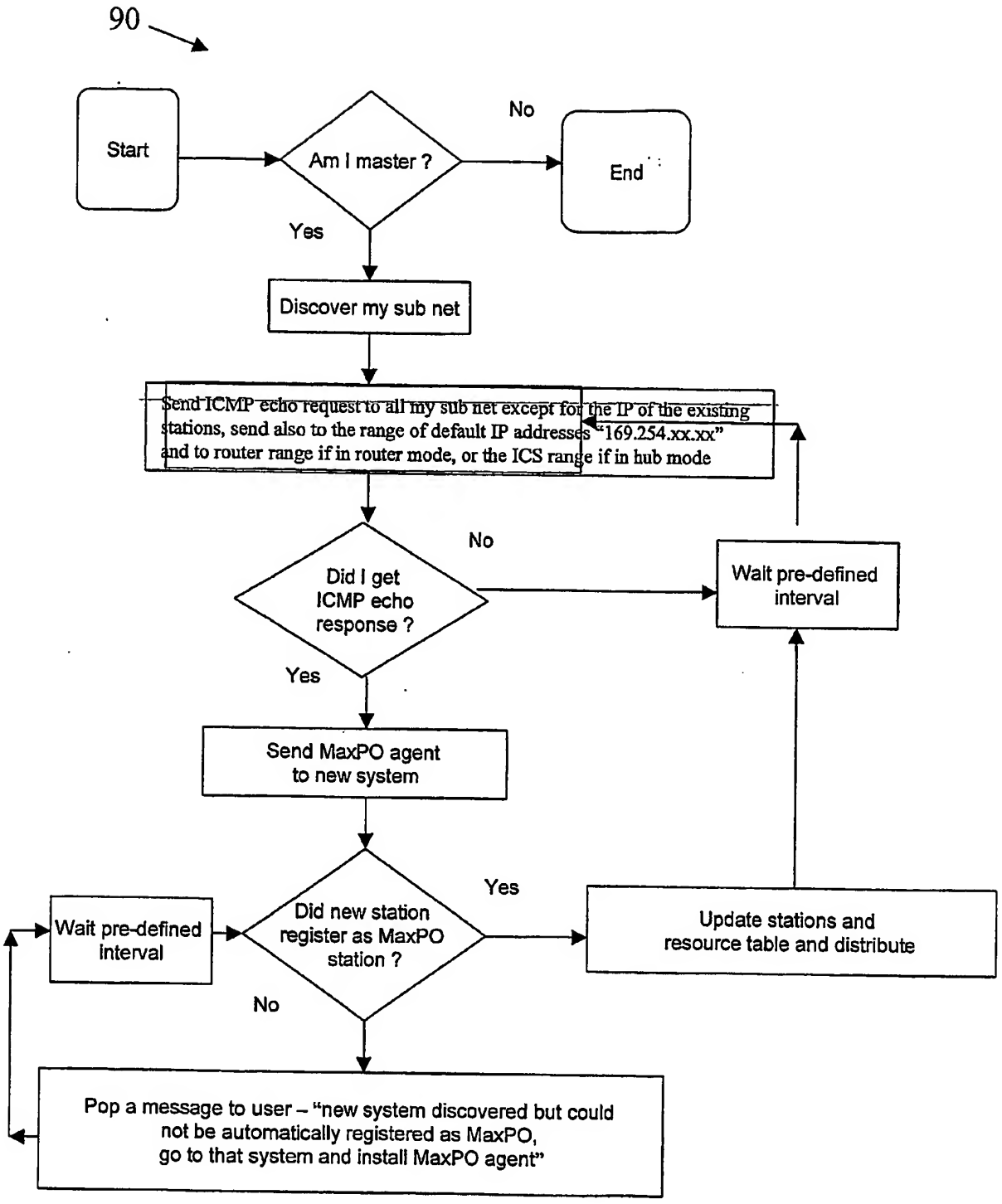

90
Start
Am I master ?
No
End
Yes
Discover my sub net
Send ICMP echo request to all my sub net except for the IP of the existing stations, send also to the range of default IP addresses "169.254.xx.xx" and to router range if in router mode, or the ICS range if in hub mode
Did I get ICMP echo response ?
No
Wait pre-defined interval
Yes
Send MaxPO agent to new system
Did new station register as MaxPO station ?
Yes
Update stations and resource table and distribute
Wait pre-defined interval
No
Pop a message to user – "new system discovered but could not be automatically registered as MaxPO, go to that system and install MaxPO agent"

Fig. 10

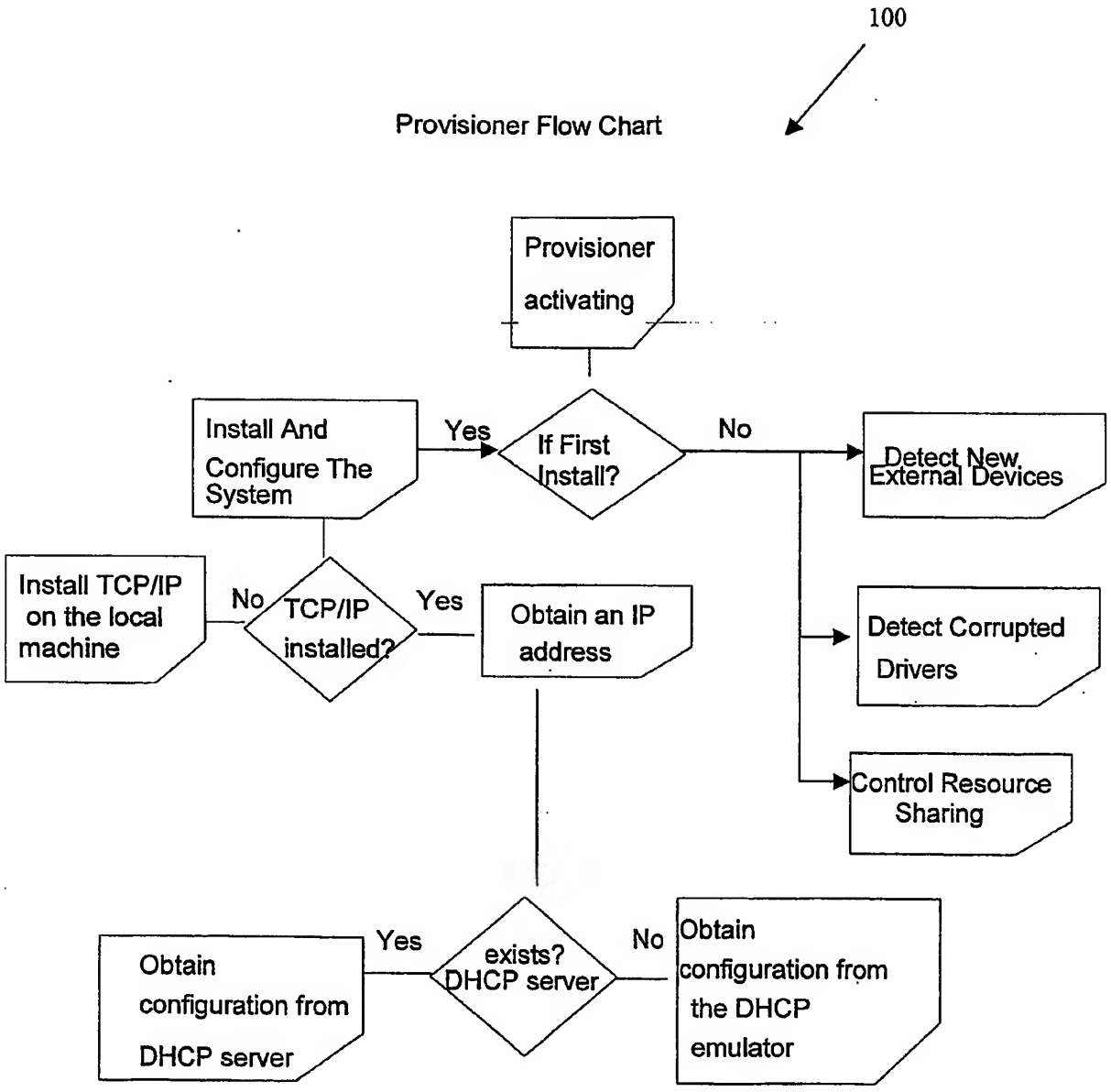

100
Provisioner Flow Chart
Provisioner activating
If First Install?
Yes
No
Install And Configure The System
Detect New External Devices
Install TCP/IP on the local machine
No
TCP/IP installed?
Yes
Obtain an IP address
Detect Corrupted Drivers
Control Resource Sharing
exists? DHCP server
Yes
No
Obtain configuration from DHCP server
Obtain configuration from the DHCP emulator

Fig. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL03/00945

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : G06F 15/177
US CL : 709/220, 224
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 709/220, 221, 222, 223, 224

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,460,070 B1 (TUREK et al) 01 October 2002 (01.10.2002). col.2 lines 26-45.	1-25
Y,P	US 2003/0046382 A1 (NICK) 06 March 2003 (06.03.2003), fig.1 & abstract.	1-25
Y	US 5,796,633 A (BURGESS et al.) 18 August 1998 (18.08.1998), col.3 lines 37-65.	1-25
Y,E	US 6,681,232 B1 (SISTANIZADEH et al.) 20 January 2004 (20.01.2004), abstract.	1-25

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 March 2004 (30.03.2004)	20 APR 2004
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703)305-3230	Authorized officer Dung Dinh Telephone No. 305 9600

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